

# **Fernando M. Cucchietti**

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## ***Education***

- Ph. D in Physics, Universidad de Cordoba, Argentina, 3/99 – 6/04  
Thesis dissertation: *The Loschmidt echo in classically chaotic systems: Quantum Chaos, Irreversibility and Decoherence.*  
Advisor: Dr. Horacio M. Pastawski. GPA: 10/10
- M. Sc. in Physics, Universidad de Cordoba, Argentina, 3/94 – 12/98  
Area of specialization: Electronic transport through mesoscopic devices.  
GPA: 8.14/10

## ***Honors and awards***

- Graduate Research Assistantship at Theoretical Division, Los Alamos National Laboratory (Mentor W. H. Zurek) Jan-2003/Present
- ECOS-Sud Programme fellowship, Strasbourg, France (Advisor R. A. Jalabert) Jun/Sep-2001
- Research fellowship, Antorchas Foundation, Rio de Janeiro, Brazil (Advisors E. R. Mucciolo and C. H. Lewenkopf) Jan-2001
- Research fellowship, SECYT-University of Cordoba (Advisor H. M. Pastawski) 1999-2002
- *1999 University Prize*, Universidad de Cordoba, Honor Mention to the best GPA.
- Referee for the Physical Review A and Physical Review E
- Peer reviewer for the Office of Basic Energy Sciences in the Department of Energy

## ***Research Experience***

### ***Research at Los Alamos National Lab***

- Analytical and numerical studies of decoherence due to spin environments. Implementation of Trotter-Suzuki numerical algorithms to many body systems, allowing the simulation of quantum dynamics of systems with order 30 spins in desktop-size personal computers.
- Investigations of efficient simulation of quantum dynamics in Bose-Hubbard like models, aimed at providing numerical support to optical lattice implementations of quantum computers. The same code is being used to study the quantum phase

transition of this model, helping to develop a many body Wigner function for indistinguishable particles.

#### ***Thesis related research at University of Córdoba***

- Theoretical investigations of quantum chaos, decoherence and irreversibility in classically chaotic systems.
- Development of analytical techniques that implement semiclassical approximations to hard-wall systems and to Wigner functions.
- Implementation of fast and efficient numerical algorithms (Trotter-Suzuki) to simulate one particle quantum dynamics in discretized potentials. Extension of the algorithm to hard wall potentials, as well as development of a parallel, high performance code implementation.

#### ***Other research***

- Experimental research using nuclear magnetic resonance. Performed experiments leading to the characterization of previously unknown heating effects of commonly used pulse sequences in liquid crystals. Also studied Loschmidt echoes (known as polarization echoes in the NMR community) in liquid crystals and in crystal powders.
- Studies of electron dynamics in quasi-one dimensional mesoscopic wires (M. Sc. thesis). Observation of anomalous diffusion in Anderson disorder models.

#### ***Research interests***

- Quantum computing and quantum information theory, especially quantum algorithms and physics simulations
- Decoherence and the quantum classical transition.
- Quantum and classical chaos.
- Nuclear magnetic resonance, especially in the quantum computing context.
- Electron transport in mesoscopic devices and molecular electronics.

#### ***Teaching Experience***

- Teaching assistant in charge of problems class, FaMAF Universidad de Córdoba, Argentina, 1997-2001. Taught Quantum Mechanics and Solid State Physics for the physics career, and Physics and Introduction to Algorithms for the computer science career.

#### ***Refereed Publications***

- 1) “Universality of the Lyapunov regime of the Loschmidt echo”, F.M. Cucchietti, H.M. Pastawski and R.A. Jalabert, Phys. Rev. B **70**, 035311 (2004).
- 2) "Decoherence and the Loschmidt echo", F. M. Cucchietti, D. A R. Dalvit, J. P. Paz and W. H. Zurek, Phys. Rev. Lett. **91**, 210403 (2003). This work was featured

- in *The Economist*, April 3<sup>rd</sup> 2004, page 81 (also published online version [http://www.economist.com/science/displayStory.cfm?story\\_id=2552866](http://www.economist.com/science/displayStory.cfm?story_id=2552866)).
- 3) "Many-spin quantum dynamics during cross polarization in 8CB", A. K. Chattah, G. A. Alvarez, P. R. Levstein, F. M. Cucchietti, H. M. Pastawski, J. Raya, and J. Hirschinger, *J. Chem. Phys.* **119**, 7943 (2003)
  - 4) "Sensitivity to Perturbations in a Quantum Chaotic Billiard", D. A. Wisniacki, E. G. Vergini, H. M. Pastawski and F. M. Cucchietti, *Phys. Rev. E* **65** 055206(R) (2002)
  - 5) "Measuring the Lyapunov Exponent Using Quantum Mechanics", F.M. Cucchietti, C.H. Lewenkopf, E.R. Mucciolo, H.M. Pastawski and R.O. Vallejos, *Phys. Rev. E* **65**, 046209 (2002)
  - 6) "Decoherence as decay of the Loschmidt echo in a Lorentz gas", F. M. Cucchietti, H. M. Pastawski and D. A. Wisniacki, *Phys. Rev. E* **65**, 045206(R) (2002). This work was featured in the April 2002 issue of the Virtual Journal of Quantum Information (<http://www.vjquantuminfo.org>)
  - 7) "Radiofrequency Induced Temperature Increase as a Function of Cross Polarization Contact Time in 8CB", A.K. Chattah, F.M.Cucchietti, M. Hologne, J. Raya and P.R. Levstein, *Magnetic Resonance in Chemistry* **40**, 772 (2002).
  - 8) "Decoherence in Classically Chaotic Systems", F. M. Cucchietti, H. M. Pastawski and R. Jalabert, *Physica A* **283**, 285 (2000)
  - 9) "Anomalous Diffusion in Quasi One Dimensional Systems", F.M. Cucchietti and H. M. Pastawski, *Physica A* **283**, 302 (2000)
  - 10) "Gaussian Decoherence from Random Spin Environments", W.H. Zurek, F.M. Cucchietti and J.P. Paz, quant-ph/0312207.

### ***Unpublished/other work***

- "Gaussian Decoherence from Random Spin Environments", W.H. Zurek, F.M. Cucchietti and J.P. Paz, quant-ph/0312207.
- "Dinámica difusiva y decaimiento exponencial en soluciones exactas de la ecuación de Schrödinger", F.M. Cucchietti, H.M. Pastawski, G. Usaj y E. Medina, *Anales Asociación Física Argentina Volumen 10*.

### ***Seminars and invited talks***

- "The Loschmidt echo: Universality, decoherence and the quantum-classical transition", Panamerican Advanced Institute for Physics (PASI) on the Physics of Information, Buzios, Brasiol, December 2003.
- "The Loschmidt echo: Universality, decoherence and the quantum-classical transition", seminar, Harvard University, Cambridge MA, September 2003.
- "Universality of the Lyapunov regime of the Loschmidt echo", APS March Meeting, Austin TX, USA, March 2003.

- "Universality of the Lyapunov regime of the Loschmidt echo", Quantum Institute visitor symposia (aka Quantum Lunch), LANL, Los Alamos NM, February 2003.
- "Efficient simulation of quantum dynamics in one and many body systems", Ph. D. Qualifying seminar, Universidad Nacional de Córdoba, Argentina, May 2004.
- "Electronic transport in quantum dots", Ph. D. Qualifying seminar, Universidad Nacional de Córdoba, Argentina, October 2002
- "Quantum computation", M. Sc. Qualifying seminar, Universidad Nacional de Córdoba, Argentina, December 1998

### **Conference presentations**

- "Decoherence and the Loschmidt echo", F.M. Cucchietti, D.A.R. Dalvit, J.P. Paz and W.H. Zurek, Panamerican Advanced Institute for Physics (PASI) on the Physics of Information, Buzios, Brasil, December 2003.
- "Decay of the Loschmidt Echo as a Sensor for the Unpredictability of the Quantum Phase in Classically Chaotic Systems", F. M. Cucchietti, H. M. Pastawski, R. Jalabert, D. A. Wisniacki, E. Vergini, E. R. Mucciolo, C. H. Lewenkopf and R. O. Vallejos, Ecole predoctoral de Physique Mesoscopique, Les Houches, Francia, Septiembre 2001
- "Decoherence And Quantum Chaos In The Diffusive Transport Regime" F. M. Cucchietti and H. M. Pastawski, Panamerican Advanced Study Institute Workshop on Chaos, Decoherence and Quantum Entanglement, Ushuaia, Argentina, October 2000.
- "Decoherence in Classically Chaotic Systems", F. M. Cucchietti, H. M. Pastawski and R. Jalabert, VI Latin American Workshop on Nonlinear Phenomena (LAWNP 99), Huerta Grande, Argentina, October 1999.

### **Schools/workshops attended**

- Pan American Advanced Study Institute on the Physics of Information, Buzios, Brazil, December 2003
- Workshop in Electron Interaction and Mesoscopic Devices, ICTP, Trieste, Italy, June-July 2002
- Ecole de Physique Mesoscopique, Les Houches, France, September 2001
- Pan American Advanced Study Institute on "Chaos, decoherence and quantum entanglement: towards quantum classical correspondence", Ushuaia, Argentina, October 2000
- First Winter School J.J.Giambiagi, Recent Advances In Condensed Matter Physics, University of Buenos Aires, Argentina, July 1999

### **Personal information**

Birth: 06/22/1976 - Citizenship: Argentina